

DEPARTMENT OF ECONOMICS

HOW DO ALTERNATIVE MINIMUM WAGE VARIABLES COMPARE?

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**Working Paper No. 05/6
March 2005**

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March 18, 2005

Abstract

Several minimum wage variables have been suggested in the literature. Such a variety of variables makes it difficult to compare the associated estimates across studies. One problem is that these estimates are not always calibrated to represent the effect of a 10% increase in the minimum wage. Another problem is that these estimates measure the effect of the minimum wage on the employment of different groups of workers. In this paper we critically compare employment effect estimates using five minimum wage variables common in the literature: real minimum wage, “Kaitz index”, “fraction affected”, “fraction at” and “fraction below” the minimum wage. Our principal finding is that the sign of this effect is robust across minimum wage variables, but its magnitude and significance are sensitive to the minimum wage variable used.

Keywords: minimum wage, labour cost, employment, hours, Brazil.

JEL code: J38.

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[†]Special thanks to Arthur Van Soest, Charles Brown, Daniel Hamermesh, David Neumark, David Wittenburg, Gianni De Fraja, Jerzy Szroeter, Steve Machin and Steve Wheatley Price. Also thanks to comments of various participants in the following conferences: SOLE-US, ESPE-Spain, EEA-Italy, LAMES-Brazil, RES-England, SBE-Brazil, LACEA-Mexico.

1 Introduction

Several minimum wage variables have been suggested in the literature to estimate the effect of the minimum wage on employment. Among them, the “Kaitz index”, the real minimum wage, the “fraction affected”, the “fraction at” and the “fraction below”, described in detail below.¹ Such a variety of variables makes it difficult to compare the associated estimates across studies.

One problem is that these variables are not really comparable because the estimates using different minimum wage variables are not always calibrated to represent the effect of a 10% increase in the minimum wage on employment. The implicit assumption when using the “Kaitz index” or the real minimum wage, for instance, is that minimum wage increases do not affect the average wages or overall price level substantially. If the variation in the ratio comes from the variation in the nominal minimum wage, a 1% increase in the ratio is taken to represent a 1% increase in the nominal minimum wage. However, a 1% increase in the “fraction affected”, “fraction at” or “fraction below” variables cannot be taken to represent a 1% increase in the nominal minimum wage. This is because the elasticities of these variables with respect to the nominal minimum wage are not all -1. Lemos (2005) shows that comparing estimates before calibration is misleading.

Another problem is that these variables are not really comparable because different minimum wage variables might simply measure the effect of the minimum wage on different groups of workers. For example, while “fraction affected” measures the costs of increasing the wages of those just above the minimum wage, “fraction below” measures the costs of increasing the wages of those below the minimum wage. Consequently, the magnitude of the employment effect will depend on whether there are more workers just above or below the minimum wage and to what extent they are affected. Or put differently, the magnitude of the employment effect will depend on the extent of wage spillover effects just above and below the minimum wage. The magnitudes of the estimates might not differ much in a country where the fraction variables are small, such as the US or the UK, for which most of the literature is available. However, the magnitude of the estimates will substantially differ in a country where a minimum wage increase affects a large fraction of workers above and below the minimum wage, and where the relative sizes of these fractions differ. For example, in Brazil there are more workers below the minimum wage than between the old and new minimum wage. Thus, we might expect the estimates of “fraction below” to be larger than the estimates of “fraction affected”.

¹The “Kaitz index” is the ratio of the minimum wage to average wages (Kaitz, 1970), the “fraction affected” is the proportion of workers affected by a minimum wage increase (Card and Krueger, 1995), “fraction at” is the proportion of workers earning the minimum wage (Dolado et al., 1996; Lemos, 2005), and “fraction below” is the proportion of workers earning below the minimum wage (Dolado et al, 1996; Neumark et al, 2005). These variables are described in detail below.

Because of these two main problems, part of the recent controversy in the literature over the magnitude, significance and direction of the minimum wage employment effect might be that non-directly comparable estimates are being compared. For instance, Neumark and Wascher (1992) found negative employment effects for the US when using the “Kaitz index”, while Card and Krueger (1995) found non-significant employment effects for the US when using the “fraction affected” as their minimum wage variable.

In this paper we critically compare employment effect estimates using the above five minimum wage variables. The aim is to assess whether the estimates are sensitive to different minimum wage variables and whether this plays a role in the debate over the minimum wage employment effect. The data we use is from the Brazilian monthly household survey panel from 1982 to 2000.

Our principal finding is that the negative sign of the employment effect is robust across minimum wage variables, but its magnitude and significance are sensitive to the minimum wage variable used. This is because different minimum wage variables measure the effect of the minimum wage on different groups of workers. We show that the estimates of minimum wage variables that capture more wage spillover effects are more negative and more robust. The remainder of this paper is organized as follows. In Section 2 we describe the data, in Section 3 we define and compare the various minimum wage variables, and in Section 4 we describe our empirical approach. In Section 5 we address identification issues and discuss our results. In Section 6 we present robustness checks.

2 Data and Descriptive Analysis

The minimum wage in Brazil is national. The coverage of the minimum wage is full across regions and individuals, though for some workers accommodation and food costs can be deducted from their wages, resulting in below minimum wage pay. Informal sector workers and those in firms where compliance is incomplete may also earn wages that are lower than the minimum wage. The minimum wage data we use is from the Labour Ministry (Ministerio do Trabalho) and the deflator is the CPI (IPC) across regions calculated by the Brazilian Institute of Statistics and Geography (IBGE).

After its introduction in 1940, the real minimum wage was devalued before it was adjusted during the boom of the 1950s. It then again declined during the subsequent recession. Since the mid 1960s, when the dictatorship was installed in the country, the real minimum wage has been systematically devalued because the government associated the then high inflation with wage adjustments. The minimum wage continued to be devalued throughout the 1980s and most

of the 1990s, despite the end of the dictatorship in the late 1980s. Since the mid 1990s, under reasonably low inflation, the real minimum wage has been relatively stable. In Figure 1 we plot the nominal and real minimum wage for Brazil between January 1982 and January 2000. The real minimum wage clearly shows a negative trend in the period. Minimum wage increases during this period were subject to the rules of five different stabilization plans. The increases were large and frequent, but quickly eroded by the subsequent inflation, resulting in the saw-toothed pattern in Figure 1.

The other data we use is from the Brazilian Monthly Employment Survey (PME). The PME is a rotating household panel similar to the US Current Population Survey (CPS). Households are interviewed for four consecutive months, not interviewed for the following eight months, and then interviewed again for four additional months. In the PME the panels are refreshed every two years, rather than every year, as in the CPS. This data has been collected by the IBGE for the six main Brazilian metropolitan regions (Salvador, Recife, Belo Horizonte, Rio de Janeiro, Sao Paulo and Porto Alegre) since January of 1982. We aggregate the data across regions and across months; the average number of observations per region-month cell was 13,000. In Table 1 we present descriptive statistics for the variables we use in our empirical models below. The cross-region variation in the data is considerable and we exploit this in order to identify the minimum wage effect on employment. For example, our employment variable, the employment rate, varies from 0.83 to 0.98.² In Figure 2 we show that the cross-time variation in the employment rate and in our minimum wage variables is also substantial. The raw correlation between the employment rate and the real minimum wage is 0.16 (correlations are reported for the national aggregate unless otherwise stated).

3 Minimum Wage Variables

Our first minimum wage variable is the real minimum wage, described above. Our second minimum wage variable is the most common one in the literature, the “Kaitz index” (Kaitz, 1970), defined as the ratio of the minimum wage to average wage adjusted for coverage (coverage is 100% in Brazil). The variation in the “Kaitz index” across regions and time, shown in Table 1, is from 0.11 to 0.57. This compares with the “Kaitz index” for the US and the UK, which was 0.39 and 0.40 in 1993 (Dolado et al., 1996). Figure 3 shows the variation in the “Kaitz index” in the national aggregate over time. Its correlation with the real minimum wage is 0.81.

The next minimum wage variable we use is the “fraction affected” by the minimum wage

²The employment rate is defined as $\frac{N_e}{N}$, where N and N_e are the sample sizes of the labour force and working population respectively.

(Card, 1992), defined as the fraction of workers affected by a minimum wage increase, i.e. the fraction of workers for whom $w_{t-1} \in [w_{t-1}^m, w_t^m]$, where w^m is the nominal minimum wage and w is nominal wages.³ “Fraction affected” is zero whenever the minimum wage is constant.⁴ Whenever it is non-zero, its magnitude depends on the size of the increase and on the initial level and shape of the wage distribution across regions. In Table 1 we show that “fraction affected” varies between 0% and 49%, with an average of 8% and a standard deviation of 12%. This compares with the 7.4% “fraction affected” in the US in 1990 (Card and Krueger, 1995). Figure 3 shows “fraction affected” in the national aggregate over time. Its correlation with the real minimum wage is 0.57.

A closely related variable is “fraction at” the minimum wage (Dolado et al., 1996), defined as the fraction of workers earning the minimum wage. “Fraction at” responds to minimum wage increases; it is bigger after an increase and smaller as workers wage bargain (Card and Krueger, 1995). This is accentuated if inflation is high and the minimum wage is constant, as illustrated in Figure 3. As a result, “fraction at” has more variation over time than “fraction affected”, which is reflected in its higher correlation with the real minimum wage, 0.64. In Table 1 we show that “fraction at” is 12% on average, with a 6% standard deviation. This compares with the 4% “fraction at” figure for the US in 1993 (Dolado et al., 1996).

Our fifth minimum wage variable, related to the previous two, is “fraction below” the minimum wage (Dolado et al., 1996), defined as the fraction of workers earning wages below the minimum wage. This suggests that larger minimum wage increases trap more workers below the minimum wage, and therefore “fraction below” also moves in response to minimum wage increases. “Fraction below” varies between 1% and 43%, with an average of 12% and a standard deviation of 9%. It has more variation over time than the previous two variables, as shown in Figure 3. Its correlation with the real minimum wage is 0.71.

The above five variables are measures of the bite of the minimum wage. “Kaitz index” and the real minimum wage itself, are “relative minimum wage measures”. The others are “degree of impact measures” (Brown, 1999) because they focus on the fraction of workers directly affected by minimum wage increases: “fraction affected” is a measure of the potential effect of the increase, “fraction at”, is a measure of the effectiveness of the increase, and “fraction below” is a measure of the non-compliance with the increase.

³In practice, for the case of Brazil, we define this interval as $w_{t-1} \in [0.98w_{t-1}^m, 1.02w_t^m]$. The bounds account for measurement error introduced by rounding approximations. This is because in the presence of high inflation as in Brazil, people tend to report rounded wages. All estimates in the paper were robust to defining “fraction affected” with and without bounds (the correlation between the two is 0.91). Similarly, we define the interval for “fraction at” as $w_t \in [0.98w_t^m, 1.02w_t^m]$, and “fraction below” as $w_t \in [-\infty, 0.98w_t^m]$.

⁴That is because conceptually, no worker is affected by a minimum wage increase when there is no increase.

3.1 Sources of Variation in the Minimum Wage Variables

“Relative minimum wage measures” are commonly used in empirical employment models because they are grounded on the standard neoclassical model (Card and Krueger, 1995; Williams, 1993). The implicit assumption is that the minimum wage varies across regions. If however the minimum wage is national, as it is in Brazil, the numerator is constant and the variation in the ratio is driven by the variation in the denominator. As a result, the effect of the inverse of wages (or prices) on employment is what is ultimately estimated in empirical models (Welch and Cunningham, 1978).

Although a national minimum wage is a difficulty when defining “relative minimum wage measures” empirically, it does make it possible to define “degree of impact measures”. This is because the minimum wage affects a different proportion of people in each region, depending on the initial level and shape of the wage distribution across regions. It can be argued that, as with the “relative minimum wage measures”, the ultimate source of variation in the “degree of impact measures” is the underlying wage distribution across regions. The advantage of the “degree of impact measures” is that they capture variation at the point (interval) of the distribution that really matters. Analysis based on the mean can be biased because they include people who are not affected by the minimum wage increase (Neri, 1997; Castillo-Freeman and Freeman, 1992).⁵ Furthermore, whereas an increase in the national minimum wage causes direct and immediate variation in the “degree of impact measures”, it causes only indirect and lagged variation in the “relative minimum wage measures”. This indirect variation, via average wages or prices, may be contaminated by variation in variables other than the minimum wage. While neither of these variables is immune to contamination by variation in other variables, Brown (1999, p. 2130) concludes that the “degree of impact measures” are conceptually cleaner than the “relative minimum wage measures”. Moreover, the “degree of impact measures” add variation over and above the variation in the “relative wage measures” if inequality substantially varies across regions, as it does in Brazil. Even if average wages are relatively unchanged following a minimum wage increase, the variation in the “degree of impact measures” can be substantial if the shape of the distribution is different across regions.

Among the “degree of impact measures” the amount of variation differs. Brown (1999, p. 2130) notes, “fraction affected” is “not well-suited for studying periods when the minimum wage is constant, and so its impact should be declining. While there is more to be learned from a year in which the minimum wage increases by 10 or 15% more than average wages than from a year of modest decline, the periods between increases should together contain about as much

⁵The “Kaitz index” could alternatively be defined using the percentile of the wage distribution mostly affected by the increase. However, the affected percentile varies across regions and over time, which makes the right choice difficult. In contrast, “degree of impact measures” are sensitive to the variation in the relevant percentile.

information as the periods of increase.” That is because “fraction affected” is zero regardless of how unimportant the minimum wage may become. As a result, it does not capture the erosion of the minimum wage relative to other wages. In contrast, “fraction at” varies even when the minimum wage is constant. It measures both how binding the minimum wage is when increased and how unimportant (not binding) the minimum wage is when not increased. Thus, “fraction at” has more variation, and a stronger correlation with the real minimum wage (0.64) than “fraction affected” (0.57).

To establish whether the variation in “fraction at” is a measure of the variation in the minimum wage, consider three scenarios. Firstly, if the increase is fully anticipated, allowing wage bargains which result in 100% spillovers (all workers keep their position in the wage distribution), “fraction at” is constant regardless of the size of the increase and therefore uncorrelated with it. Secondly, if the increase is fully anticipated, but wage bargains result in less than 100% spillovers, “fraction at” is correlated to the increase. The less spillovers there are, the stronger the correlation. Third, if the increase is not anticipated, no wage bargains or spillovers occur and all workers between the old and new minimum wage are squashed at the latter. “Fraction at” is then strongly correlated with the increase. Therefore, the underlying identifying restrictions for a valid control group are that a fully anticipated increase is not followed by 100% spillovers. These are fairly realistic assumptions.

The variation in “fraction below” also depends on the extent of spillovers and anticipation of the increase. It further depends on the extent of non-compliance, which depends on changes in variables other than the minimum wage. As a result, “fraction at” is a cleaner measure of the minimum wage effect, although “fraction below” has a stronger correlation with the real minimum wage (0.71). We use each of the above minimum wage variables in turn in our empirical employment model below and compare their estimates.

4 Employment Effects

4.1 Model Specification

A simple empirical employment equation standard in the literature (Brown, 1999) is:

$$\Delta \ln N_{rt} = \alpha + \beta^M \Delta \ln W_{rt}^M + \lambda \Delta X_{rt} + f_r + f_t + \epsilon_{rt} \quad (1)$$

where N_{rt} is the employment rate, W_{rt}^M is the real minimum wage, X_{rt} are labour supply shifters,

f_r and f_t are region and time fixed effects, and ϵ_{rt} is the error term in region r and month t , $r = 1, \dots, 6$, and $t = 1, \dots, 214$. Regional dummies model region growth specific trends. Supply shifters are the proportion of the total population who are younger than 10 years old, between 10 and 24 years of age, women, illiterates, retirees, students, in urban areas, with completed basic education (8 years) and high school education (11 years); the average years of schooling in the total population; the proportion of the working population holding two jobs, in the informal, public, construction and metallurgy sectors. A GLS correction is performed in all models in the paper to correct for heteroskedasticity arising from aggregation and to account for the relative importance of each region. Also, standard errors are corrected for serial correlation across and within regions.⁶

4.2 Estimates Interpretation

GLS β^M estimates, shown in row 1 and column 1 of Table 2, are statistically insignificant. The estimates are again statistically insignificant when we replace the real minimum wage in Equation 1 by the “Kaitz index”, as shown in row 1 and column 2 of Table 2. Thus, the results when using the “relative minimum wage measures” suggest that the minimum wage does not have an adverse employment effect in Brazil. However, when we replace the log of the real minimum wage in Equation 1 by the “fraction affected”, “fraction at” and “fraction below” in turn, the estimates are negative and significant, as shown in row 1 and column 3 to 5 of Table 2. Thus, the results when using the “degree of impact measures” suggest that the minimum wage has an adverse employment effect in Brazil.

The implicit assumption when using “relative minimum wage measures” is that minimum wage increases do not affect the overall price level or average wages substantially. If the variation in the ratio comes from the variation in the nominal minimum wage, a 1% increase in the ratio is taken to represent a 1% increase in the nominal minimum wage. Even assuming no wage spillovers effects and no inflationary effects, a 1% increase in the “degree of impact measures” cannot be taken to represent a 1% increase in the nominal minimum wage. That is because the elasticities of the various “degree of impact measures” with respect to the nominal minimum wage are not all -1. For example, in Section 4.3 we estimate the elasticity of the “fraction affected” with respect to the nominal minimum wage, which is 0.37. The “fraction at” elasticity is 0.06, and the “fraction below” elasticity is 0.07.

We use these elasticities to calibrate our “degree of impact measures” estimates to reflect the

⁶The GLS estimates were robust to GMM estimation using lags of the minimum wage variable as well as a number of political variables as instruments (Lemos, 2004). This suggests that any endogeneity bias arising from the simultaneous determination of “fraction at” and employment is not too severe.

effect of a 1% increase in the minimum wage, in a similar fashion to Card and Krueger (1995, p. 142). For instance, before calibration, a 1 percentage point increase in “fraction affected” decreases employment by 0.045%, as shown in row 1 and column 3 of Table 2. Card and Krueger (1995, p. 144) found estimates ranging from 0.03 to 0.36, not always significant, when regressing the change of employment-population ratio on the “fraction affected” for the US. Our estimate is more negative because of more extensive wage spillovers in Brazil (Lemos 2005; Fajnzylber, 2001). After calibration, a 1% increase in the nominal minimum wage (increases “fraction affected” by 0.37 percentage points) decreases employment by 0.017%, as shown in row 2 of Table 2.

While the estimate of “fraction affected” is -0.017, the estimate of “fraction at” is -0.006. The former is larger because “fraction affected” embraces a larger proportion of workers and therefore measures higher extra wage costs (wage spillovers just above the minimum wage). The estimate of “fraction below” is -0.008, which is also larger than the estimate of “fraction at” because “fraction below” also embraces a larger proportion of workers and therefore also measures higher extra wage costs (wage spillovers below the minimum wage). Furthermore, the “fraction affected” estimate is larger than the “fraction below” estimate, suggesting that the spillovers just above the minimum wage are larger than the spillovers below the minimum wage.

4.3 Calibration Method

The main drawback with the interpretation of the estimates above is that it is completely reliant on the robustness of the elasticity estimates used to calibrate the raw “degree of impact measures” estimates. The issue arises when extending the calibration method used by Card and Krueger (1995, p. 142) to the context of multiple time series over regions. Card and Krueger (1995) calculate the change in the “fraction affected” following the 1990-1991 nominal minimum wage increase and use this figure to calibrate their “fraction affected” estimates. As we have several nominal minimum wage increases, the analogue here is to regress “fraction affected” on the difference of log nominal minimum wage and the other regressors in Equation 1 (Lemos, 2005):⁷

$$F_{rt} = a + b\Delta \ln w_t^m + c\Delta X_{rt} + g_r + g_t + e_{rt} \quad (2)$$

where F_{rt} is “fraction affected”, w_t^m is the nominal minimum wage as defined earlier, g_r and g_t are region and time fixed effects, and e_{rt} is the error term. However, because the nominal

⁷Lemos (2005) uses a deterministic model to give the intuition. Let $y = a_1 + b_1x$, $y = a_2 + b_2z$, and $z = a_3 + b_3x$; then $b_1 = b_2b_3$, $\forall b_1, b_2, b_3 \neq 0$. In non-deterministic models, the more precise the estimates are, the better b_1 approximates b_2b_3 . This is equivalent to using the nominal minimum wage as an instrument for the “fraction affected”. The reduced form equation is obtained by substituting Equation (2) into Equation (1).

minimum wage does not vary across regions, b is not identified in Equation 2. We thus replace the nominal minimum wage in Equation 2 by the “Kaitz index” and obtain an estimate of 0.37 with standard errors of 0.05. This is the elasticity we use above to calibrate our “fraction affected” estimates. The 0.06 “fraction at” elasticity with standard errors of 0.30, and the 0.07 “fraction below” elasticity with standard errors of 0.33 were obtained in a similar manner. As we discussed in Section 3.1, our main concern is that the 0.37 estimate does not fully identify the effect of the minimum wage on “fraction affected” because the variation in the “Kaitz index” is driven by the variation in average wages.

5 Identification

Without a robust and fully identified estimate of the “fraction affected” elasticity to calibrate the raw estimate of “fraction affected” from Equation 1, the interpretation of this raw estimate is not straightforward. This is because the raw estimate is informative of the change in employment given a change in the proportion of workers affected by the minimum wage increase but not given a change in the minimum wage itself, which is the relevant policy variable. Another way to use the “fraction affected” to measure the impact of a national minimum wage is to interact the two. This gives a weighted minimum wage, where the impact of a national minimum wage increase in each region is measured by the proportion of workers directly affected by the increase in that region. This is a more intuitive and more policy relevant minimum wage variable. Thus, we modify Equation 1 in the following way:

$$\Delta \ln N_{rt} = \alpha + \beta^M \Delta \ln w_t^M + \beta^F F_{rt} + \beta F_{rt} \Delta \ln w_t^m + \lambda \Delta X_{rt} + f_r + f_t + u_{rt} \quad (3)$$

where β is the coefficient of interest and u_{rt} is the new error term. Although β^M is not identified, the effect of the nominal minimum wage is controlled for in the model because it is expanded out in the time effects and thus the other coefficients in the equation are adequately estimated. Thus, we interpret the β coefficient as deviations from the mean effect that would have been captured by β^M , but instead is captured by the time effects. We estimate Equation 3 taking F_{rt} to mean in turn “fraction affected”, “fraction at” and “fraction below”.

The results when using “fraction affected”, shown in row 3 of Table 2, indicate that a 1% increase in the weighted nominal minimum wage decreases employment by 0.024%. As before, this effect is smaller when using “fraction at” and larger when using “fraction below”, as shown in row 3 of Table 2. This is because the last two account for wage spillover effects. These results now

suggest that spillovers below the minimum wage are larger than spillovers just above it. Table 1 confirms that “fraction below” is larger than “fraction affected”. Our results indicate that increasing the wages of those at the minimum wage by 1% does not adversely affect employment, as the “fraction at” estimates are not significant. However, increasing the wages of those below the minimum wage by 1% decreases employment by 0.037%, while increasing the wages of those just above the minimum wage by 1% decreases employment by 0.024%.

5.1 Robustness Checks

A potential criticism with the specification of Equation 3 is that the change in the nominal minimum wage is zero when the nominal minimum wage is held constant. Thus, the interaction term is zero not only when using “fraction affected”, as discussed in Section 3.1, but also when using “fraction at” and “fraction below”. As a result, we fail to exploit the variation in the last two variables associated to the erosion of the minimum wage relative to other wages. We check the robustness of our results to this criticism by modifying our estimation strategy in two different ways. Firstly, we restrict the analysis to time periods in which there was an increase in the minimum wage by dropping the time periods in which the interaction term is zero. The estimates are now larger, as shown in row 4 of Table 2, although they follow the same pattern of signs, significance and relative magnitudes.

Secondly, in order to capture the erosion of the minimum wage in relation to other wages and prices, we replace the nominal minimum wage in Equation 3 by the real minimum wage. We again interpret the β coefficient as deviations from annual means. That is because, as before, the mean minimum wage effect that would be captured by β^M is instead captured by the time effects, and β^M simply captures the effect of the inverse of prices on employment. The estimate of “fraction affected” is as large as it was when using the nominal minimum wage and a full sample (row 3), and the “fraction below” estimate is roughly the same size as when using the nominal minimum wage and a restricted sample (row 4). The estimate of “fraction at” remains insignificant, as shown in row 5 of Table 2. Neumark et al. (2003) estimated a similar model in which, however, the real minimum wage is interacted with a dummy for low and high wage regions. The estimate of the interaction term in their most complete specification is a significant -0.024, which is remarkably in line with our results above. Our model is arguably superior to theirs because F_{rt} has variation over and above their dummy. F_{rt} varies across regions and over time and is thus a better measure of the intensity of the increase across regions. Furthermore, our model is less prone to omitted variable bias.

Our final robustness check is to allow for lagged employment responses to minimum wage

increases. The usual justifications in the literature for omitting dynamics are that the high voluntary turnover in low wage occupations allows adjustment in employment via non-replacement rather than via firing; and that the announcement of minimum wage increases prior to the enactment date allows anticipated adjustment in employment (Brown, 1999). As employment is usually reported to be AR(2) in the literature, we allow two years for full adjustment by adding 24 lags of the dependent variable in Equation 3. We find that our results are robust to this specification change. The estimate of “fraction below” is roughly the same and the estimate of “fraction at” remains insignificant, as shown in row 6 of Table 2. The estimate of “fraction affected” is now a bit larger. The long run estimates are not significant, confirming that employment adjusts fairly quickly following minimum wage increases. When allowing for dynamics, Neumark et al. (2003) also found insignificant effects in the long run in Brazil, with the short run estimate changing little in magnitude, -0.27, but becoming insignificant.

5.2 Discussion

Our results suggest that the sign of the employment effect is robust across various alternative minimum wage variables and identification strategies. As the correlation between each of the minimum wage variables and the real minimum wage is positive, this is in line with our prior expectation that the estimates should carry the same sign. However, the magnitude and significance of this effect are sensitive to both the minimum wage variable used and the identification strategy exploited. We argue that is because different minimum wage variables measure the effect of the minimum wage on different groups of workers. The more spillovers the variable measures, the larger the estimates are. For example, the estimates of “fraction below” are the largest, as they account for spillovers below the minimum wage, followed by the estimates of “fraction affected”, which account for more limited spillovers just above the minimum wage. The estimates of “fraction at”, which account for no spillover effects, are the smallest – insignificantly different from zero.

We expected the estimates of the “Kaitz index” to be the largest and most negative one, because this variable accounts for spillovers throughout the entire wage distribution. Similarly, we expected the estimates of the real minimum wage to be large and negative, because it accounts for overall wage-price spillovers. However, none of these estimates is significantly different from zero. Neumark et al. (2003) also found statistically insignificant real minimum wage estimates when estimating a similar model for Brazil. Williams (1993) estimated a similar specification for the US using the “Kaitz index” and the real minimum wage in turn, but found negative and significant estimates, respectively -0.182 and -0.325. Neumark and Washer (1992) also estimated

a similar model for the US and found “Kaitz index” estimates ranging from -0.18 to 0.06, not always significant. As we discussed in Section 3.1, the “relative minimum wage measures” do not fully identify the effect of the minimum wage on employment and thus we broadly dismiss these results, which were here reported for completeness and comparability with the literature.

Our results of up to -0.05 are small when compared to the -0.1 employment effect in the literature for other developed and developing countries (Brown, 1999; Maloney and Mendez, 2004). However, our results are in line with previous evidence for Brazil. Lemos (2005) and Neumark et al. (2003) estimated similar specifications for Brazil and found estimates in line with the above,⁸ although Fajnzylber (2001) indirectly derived employment effect estimates from their wage effect estimates and found a larger -0.1 estimate (the associated standard errors were not reported).

6 Further Robustness Checks

We investigate further why our estimates are small by restricting our sample to low wage workers and to low inflation periods, in turn. Firstly, the motivation to restrict our sample to low wage workers is that our earlier estimates are for the entire working population, which might be diluting more adverse employment effects for low wage workers (Stewart, 2002). We thus estimate Equation 3 for two groups of low wage workers in turn: teenagers (between 15 and 19 years of age), as it is usual in the US minimum wage literature (Brown, 1999), and low educated workers (those with 4 or less years of schooling). The estimates for teenagers, shown in row 7 of Table 2, are insignificantly different from zero, indicating that the minimum wage does not adversely affect teenage employment. These estimates are in line with recent evidence for US teenagers, where no adverse effects on employment have been documented (Card and Krueger, 1995). For the low wage workers, the “fraction at” and the “fraction affected” estimates remain statistically insignificant, as shown in row 8 of Table 2. The “fraction below” estimate is significant, suggesting that a 1% increase in the wages of those below the minimum wage decreases low wage workers employment by 0.069%. Thus, it appears that by increasing the wages of the lowest paid (those below the minimum wage) some of them will lose their jobs. This suggests that some of the poorest benefit least from the legislation.

Secondly, the motivation to restrict our sample to low inflation periods is that our earlier estimates are for the full sample period, which might be diluting more adverse employment

⁸Employment can be adjusted in two margins following a minimum wage increase: the number of posts of jobs and the number of hours of work. Recent research (Card and Krueger, 2000; Neumark and Wascher, 2000; Machin et al., 2003) suggests that small employment (rate) effects are a sub-product of adjustments in hours. Neumark et al. (2003) and Lemos (2005) estimated hours effect for Brazil and found little evidence of an adverse effect.

effects in low inflation periods. This is because firms might respond differently to a minimum wage increase depending on the level of inflation. In high inflation periods, firms may perceive the increase as temporary, anticipating the subsequent accommodating monetary policy and wage-price spiral. Hence they would not adjust employment to avoid adjustment costs (Cox and Oaxaca, 1981). Conversely, more adverse employment effects might be expected in low inflation periods. We thus estimate Equation 3 restricting our sample to the period after July of 1994, when inflation was brought under control. These estimates, shown in row 9 of Table 2, are insignificantly different from zero, indicating, that the minimum wage does not adversely affect employment even in low inflation.

7 Conclusion

The main goal in this paper was to assess whether estimates of the minimum wage employment effect are sensitive to different minimum wage variables and whether this plays a role in the recent debate over the minimum wage employment effect in the literature. The above estimates suggest that while the sign of the estimates is not sensitive, the magnitude and significance are. Even after calibrating the estimates of different minimum wage variables to represent the effect of a 10% increase in the minimum wage on employment, the estimates were not comparable. That is because they measure the effect of minimum wage increases on different groups of workers. The more spillovers the minimum wage variable measured, the larger the employment effect was. For example, using the estimates of our preferred specification, increasing the wages of those at the minimum wage by 1% does not adversely affect employment. However, increasing the wages of those below the minimum wage by 1% decreases employment by 0.050%, while increasing the wages of those just above the minimum wage by 1% decreases employment by 0.024%. Thus, the estimates of “fraction below” are the largest, as they account for spillovers below the minimum wage, followed by the estimates of “fraction affected”, which account for more limited spillovers just above the minimum wage. The estimates of “fraction at”, which account for no spillover effects, are insignificantly different from zero.

This is a small effect when compared with the -0.1 employment effect in the literature for other developed and developing countries, although it is in line with previous evidence for Brazil. This result was robust to various alternative identification strategies and minimum wage variables. The employment effect estimates remained small when we restricted our analysis to vulnerable groups such as teenagers and low wage workers. A fruitful avenue for future research is to compare estimates of different minimum wage variables using data for other developing and

developed countries to test the robustness of our findings. The main policy implication deriving from these results is that the minimum wage does not destroy too many jobs in Brazil.

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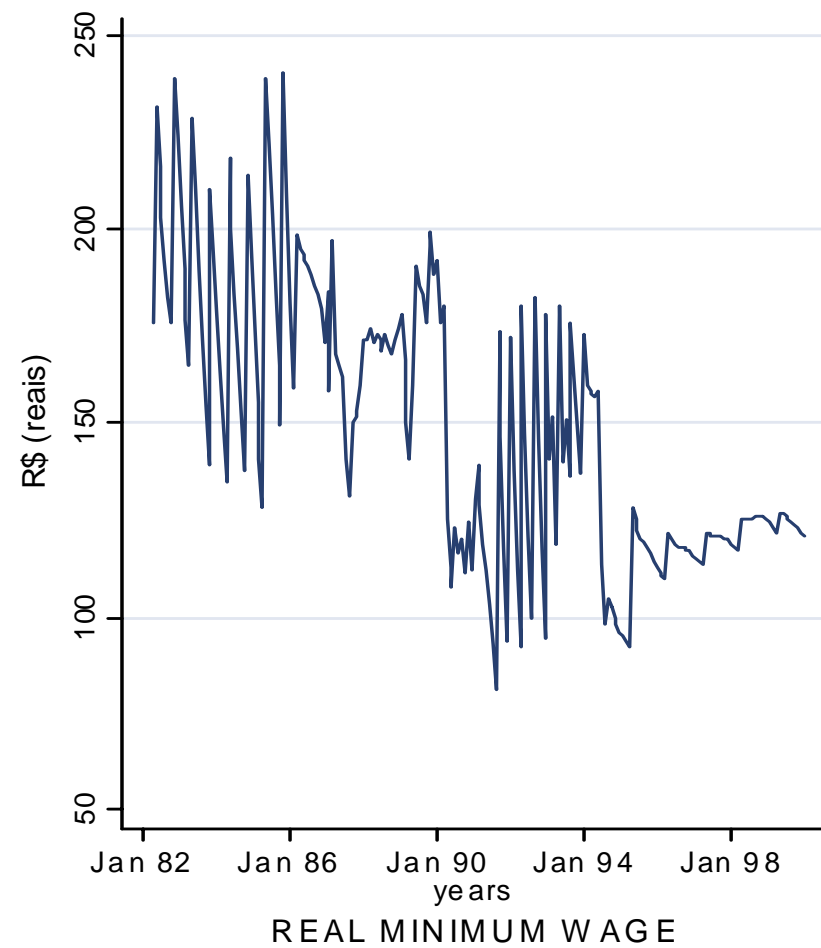
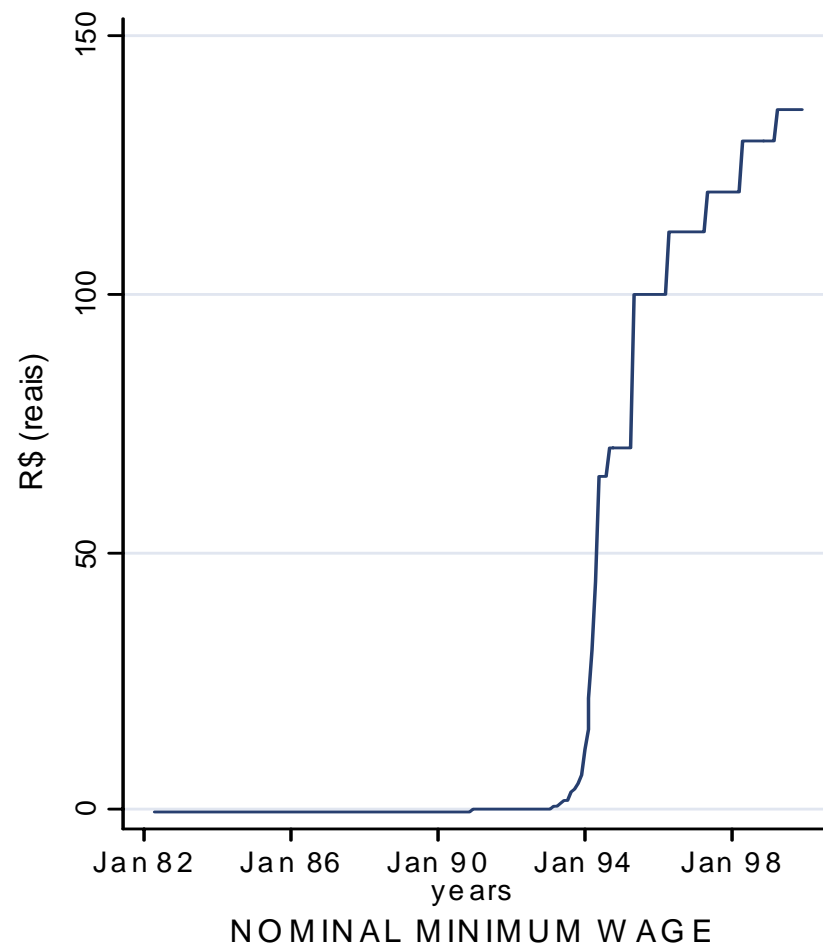


Figure 1 - THE NOMINAL AND REAL MINIMUM WAGE IN BRAZIL, 1982-2000

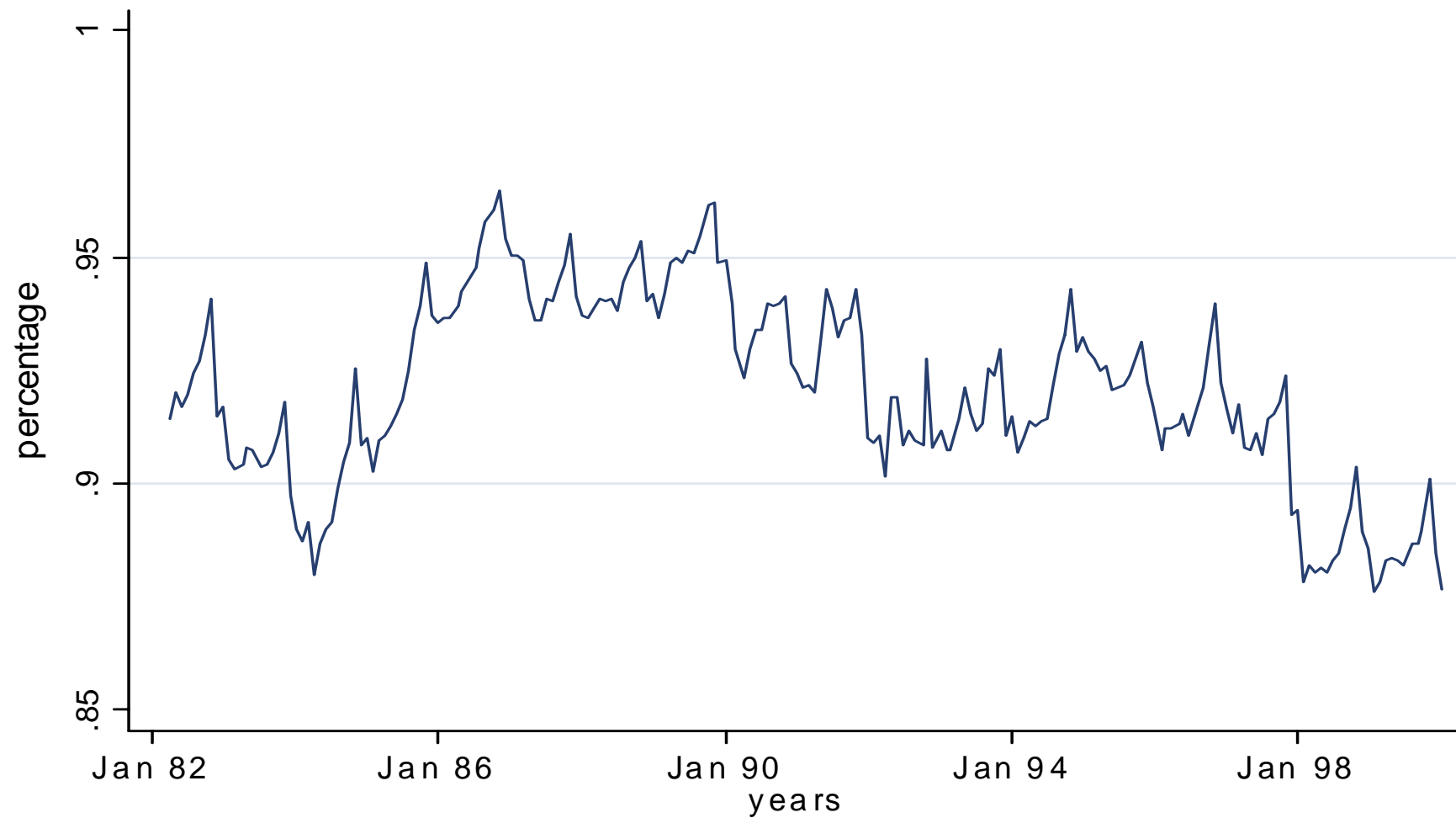


Figure 2 - THE EMPLOYMENT RATE IN BRAZIL, 1982-2000

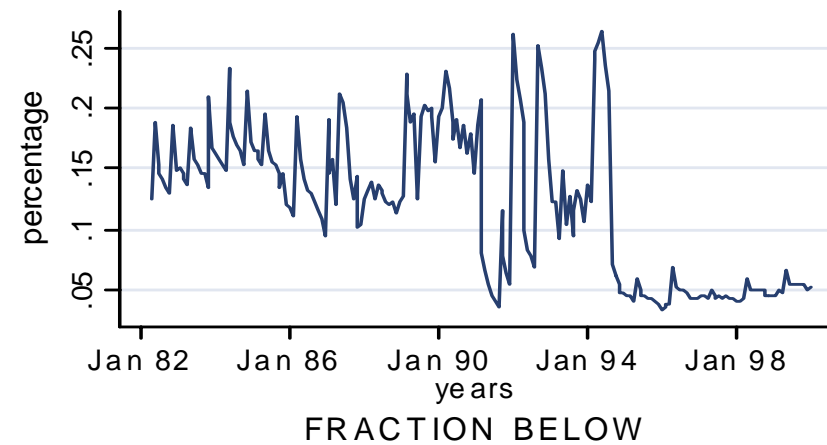
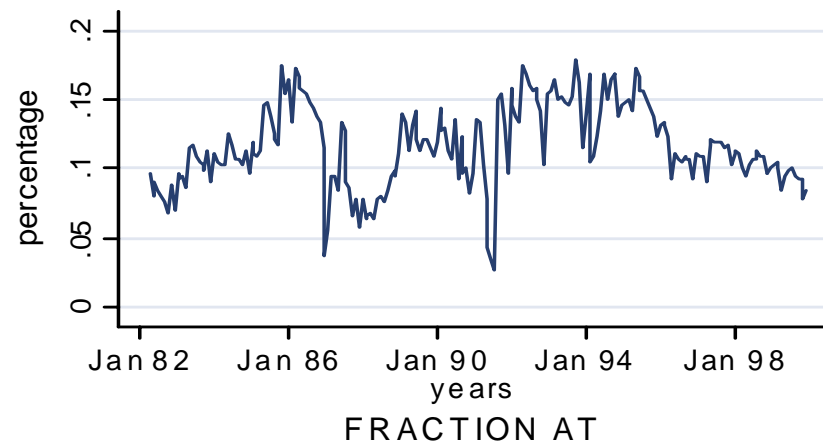
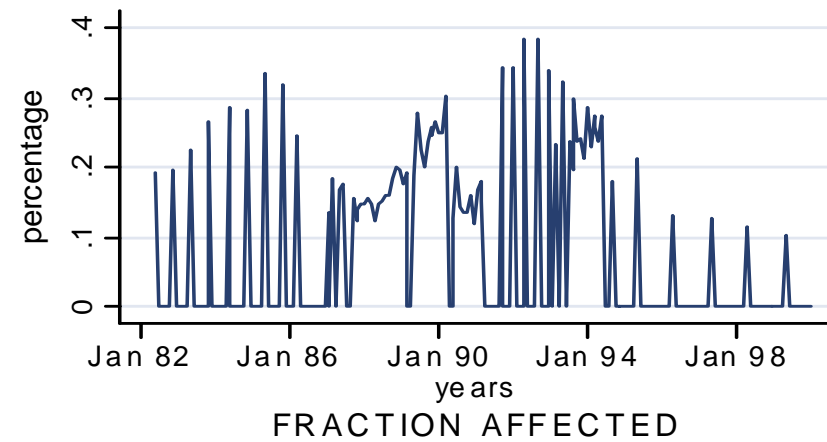
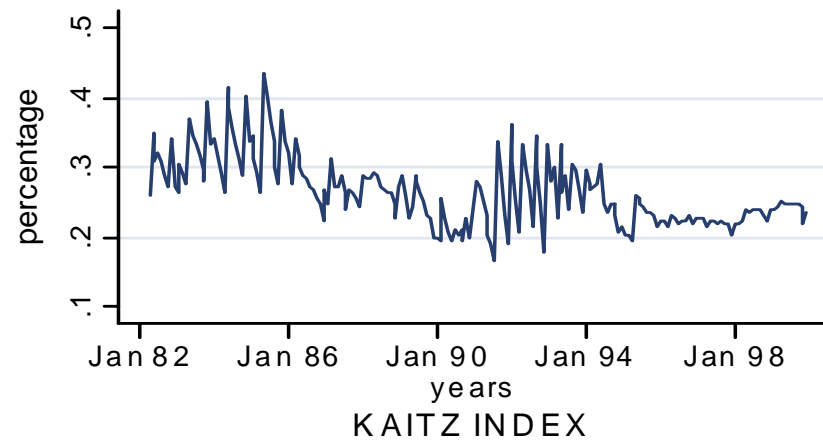


Figure 3 - MINIMUM WAGE VARIABLES IN BRAZIL, 1982-2000

Table 1 - DESCRIPTIVE STATISTICS

Variables	average	standard deviation	minimum	maximum
employment rate	0.92	0.03	0.83	0.98
nominal minimum wage	35.87	52.66	0.01	136.00
real minimum wage	149.52	37.89	70.33	289.53
average real earnings	569.47	163.55	266.25	1492.10
"Kaitz index"	0.26	0.07	0.11	0.57
"Kaitz index 50"	0.50	0.15	0.19	0.95
"fraction affected"	0.08	0.12	0.00	0.49
"fraction at"	0.12	0.06	0.01	0.29
"fraction below"	0.12	0.09	0.01	0.43
Percentage of Workers				
metallurgic industry	0.11	0.05	0.04	0.26
building construction	0.05	0.01	0.03	0.08
commerce	0.09	0.01	0.07	0.11
services	0.29	0.02	0.20	0.34
public sector	0.07	0.01	0.02	0.10
informal sector	0.31	0.06	0.17	0.44
Percentage of Population				
aged 10 to 24 years old	0.42	0.05	0.32	0.52
aged 25 to 64 years old	0.51	0.04	0.41	0.59
aged over 65 years old	0.07	0.02	0.04	0.13
women	0.45	0.02	0.40	0.49
student	0.25	0.05	0.17	0.37
enrolled in schooling	0.33	0.05	0.24	0.44
literate	0.92	0.04	0.80	0.97
elementary education (8 years of schooling)	0.39	0.06	0.27	0.51
secondary education (11 years of schooling)	0.14	0.03	0.08	0.24
graduates	0.09	0.02	0.05	0.14
retired	0.12	0.03	0.06	0.20
in urban areas	0.96	0.03	0.87	1.00

(1) These are averages over 6 regions and 214 months. The sample size before aggregation is 21,014,787 observations.

The average number of observations per region-month cell is 13,000.

Table 2 - ESTIMATES OF THE COEFFICIENT OF THE MINIMUM WAGE VARIABLE ON EMPLOYMENT MODELS

Models	Real minimum wage		Kaitz		Fraction affected		Fraction at		Fraction below	
	coefficient	st. error	coefficient	st. error	coefficient	st. error	coefficient	st. error	coefficient	st. error
	(1)		(2)		(3)		(4)		(5)	
(1) Raw coefficients	-0.073	0.053	-0.003	0.013	-0.045	0.011	-0.099	0.016	-0.118	0.013
(2) Calibrated coefficients					-0.017	0.004	-0.006	0.001	-0.008	0.001
(3) Weighted nominal minimum wage coefficients					-0.024	0.012	-0.014	0.016	-0.037	0.016
(4) Periods with nominal minimum wage increase coefficients					-0.034	0.016	-0.036	0.023	-0.048	0.021
(5) Weighted real minimum wage coefficients					-0.024	0.011	-0.035	0.022	-0.050	0.020
(6) Weighted real minimum wage coefficients with dynamics					-0.041	0.018	-0.038	0.023	-0.049	0.021
<i>long run coefficient</i>					-0.019	0.019	-0.018	0.021	-0.023	0.021
(7) Teenagers (weighted real minimum wage coefficients)					-0.030	0.059	-0.045	0.076	-0.096	0.067
(8) Low educated (weighted real minimum wage coefficients)					-0.018	0.021	-0.045	0.028	-0.069	0.025
(9) Low inflation (weighted real minimum wage coefficients)					-0.030	0.144	-0.074	0.080	-0.010	0.109

(a) These are GLS estimates where the weights are the square root of the inverse of the sample size. Standard errors (shown underneath the estimates) are White-corrected and serial correlation corrected across and within regions.

(b) The dependent variable is employment rate and the independent variable of interest is, in turn, the several minimum wage variables indicated in the table.

(c) Time effects are modeled with month dummies, region effects are modeled with region dummies, and labor supply shifters are included as controls.

(d) In row 2 the estimates in row 1 are calibrated to reflect a 1% increase in the minimum wage. "Fraction affected" estimates are multiplied by 0.37, which is the approximate elasticity of the minimum wage with respect to "fraction at". Similarly, the "fraction at" estimates are multiplied by 0.06, and the "fraction below" estimates, by 0.07.